as there are no other obvious sources of lead; Ag, Au, and Ni can come from various electronic packages, MgO from the structure itself, and $CuAl_2$ is a constituent of most copper containing aluminum alloys. Just how the $CuAl_2$ survived as an intermetallic compound, rather than as oxides of copper and aluminum, is not known. No specific sources for Si, B, and Sb are postulated, although several are possible. As the sphere was manufactured by joining two hemispheres by a weld, several coupons were cut from the material and subjected to tensile testing. Similar tests also were performed on nominal alloy samples that were exposed to simulated re-entry heating. By comparing the resulting values for yield and ultimate strength, it was concluded that the surface in general experienced a maximum temperature of 2000°F.

Space Fragment 63-24-U

A second sphere was discovered on June 29, 1963, approximately 40 miles north of the Boullia Ball site.[1] It was then retained by the Mayor of Broken Hill in southern Australia for display during a local celebration, and was subsequently shown on television in Adelaide. Believing the object to have originated from a U. S. space vehicle, they returned it to this country. Air Force investigation showed that both spheres had come from the same Agena vehicle that had been launched from Vandenberg Air Force Base in California as part of a continuing scientific space program.

A third sphere, another nitrogen tank, also was aboard but to the author's knowledge has not been recovered. The second sphere, a storage tank for nitrogen at 3600 psia, was located on the aft section of the vehicle as shown in Fig. 1. This N_2 is ejected through small nozzle clusters to provide vehicle stabilization in orbit. The re-entry conditions apparently were similar to those described for the Boullia Ball, except that a number of pie-shaped thermal control coatings were initially attached. Their presence was evident from the lightly shaded areas on the surface as compared with the heavily scaled, black portions. In this instance, however, there is an even greater degree of frontal shielding, and actual release of the sphere from the structure probably occurred at a later time than that of the Boullia Ball. Its physical characteristics are as expressed by Twiss.[1] The material used in construction by the Airite Division of the Electrada Corporation, Los Angeles, is American Society for Testing Materials (ASTM) B265/58T-Grade V-Titanium alloy.

The Smithsonian Institute, Washington, D. C., has expressed a desire to display this nitrogen tank. Since these spheres are considered to be the first re-entered fragments recovered in a condition closely resembling the original configuration, the Air Force has authorized the exhibition.

Conclusion

It is evident that the heat of re-entry does not necessarily destroy all space objects, particularly smooth objects, that re-enter from a near-earth orbit. Additional considerations that may effect survival are the melting point of the material and the amount of shielding structure which may protect an object during the high heating periods of re-entry. These points are significant for design engineers who are working on large, complex space systems intended for a limited earth orbit life. Some portion of their work may unexpectedly survive re-entry. It is hoped that such objects will land in one of the many unpopulated areas, relative to the total surface area, of the earth.

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Erratum: Heat Transfer in the Vicinity of Surface Protuberances

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THE author wishes to acknowledge the three-dimensional protuberance heat-transfer work of J. Yoshimura, currently with the Space and Information Division of North American Aviation Inc. Yoshimura's development of the reverse flow concept and correlation equations[1] formed the basis for the three-dimensional protuberance heat-transfer correlation[2] of the test data[3,4] and subsequently was presented as Eqs. (3) and (4) and Figs. 2–4 of Ref. 5.

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